

Generating hypotheses for MSE operating models and FATE Hake project

A discussion document in preparation for MSE Working Group Call #2

May 22, 2018 10-11:30a

Objectives for the call:

- Get input from the MSEWG on their views on potential hypotheses about what influences the distribution of hake within and among years to inform the FATE Hake project
- Share progress on MSE operating model development to date
- Get input from the MSEWG on initial operating model structure/assumptions and generate ideas about alternative operating model structures the MSEWG would like MSE analysts to consider

Overview of FATE Hake project:

- *Project title:* Seasonal forecasting of Pacific hake distribution in the California Current Ecosystem
- *Project contributors:* Michael Malick, Mary Hunsicker, Melissa Haltuch, Sandy Parker-Stetter, Aaron Berger, Isaac Kaplan, Kristin Marshall
- *Project objective:* Test hypotheses regarding drivers of hake spatial distribution using data collected during the summer hake acoustic surveys (12 years of data from 1995 through 2017). The project has a particular focus on studying the influence of environmental conditions on hake spatial distribution.
- *Purpose of this conversation:* Discuss with Pacific whiting fishery stakeholders their thoughts regarding what influences distribution of hake within and among years.
- *Information uses:* Information gathered from stakeholders will be used to broaden and inform the hypotheses our research explores, which in turn can be used to help inform the design of the Management Strategy Evaluation (MSE).
- *Potential questions to consider before the call:*
 - What factors influence where hake are located within a year?
 - What causes changes in hake spatial distribution across years?
 - Why are hake distributed further north in some years?

Reminder of Hake MSE Objectives:

- Evaluate the performance of current hake management procedures under alternative hypotheses about current and future environmental conditions (*links to FATE Hake project*)
- Better understand the effects of hake distribution and movement on both countries' ability to catch fish

- Better understand how fishing in each country affects the availability of fish to the other country in future years

How operating models fit in the MSE process:

Management strategy evaluation is a process that evaluates the performance of management procedures (monitoring, assessments, control rules, reference points) in the face of uncertainty. MSE relies on a set of linked, closed-loop simulations that include: 1) an operating model (OM) that simulates the underlying dynamics of a population and the fisheries, and generates survey observations and catch data from that population, 2) an estimation model (EM) performs a stock assessment based on the data from the OM, 3) a harvest control rule is applied based on the EM stock assessment, 4) the operating model is updated for the following year based on the harvest control rule (i.e., the TAC) 5) repeat x years into the future 6) evaluate pre-specified performance metrics (e.g., average catch, number of years with $SSB < 0.4 SSB_0$, etc.).

A key part of MSE is identifying important areas of uncertainty and testing performance in the face of this uncertainty. Developing multiple operating models allows us to explore one specific type of uncertainty, how much the performance of the management procedure in the simulations depend on the simplifying assumptions we make when we build a model. Some of these assumptions might include how distributional changes, movement, selectivity, and other factors are represented.

Progress on first generation spatial operating model to date:

- Age based model with similar core structure to the assessment model (i.e., recruitment deviations have the same magnitude, selectivity can vary)
- Timescale: initial years (1965-2018) + 50 years into the future. Runs 4 seasons per year (flexible). Recruitment happens only in season 1.
- Current assumptions about spatial structure and movement:
 - 2 boxes (flexible)
 - Age based movement parameters each season
 - Recruits and 1 year olds do not move
 - Movement increases with age
 - Most spawning individuals migrate south and spawn in the last season of the year
 - Stock-recruitment works per area, but have the same productivity parameters
- Generates fishery data every year (total catch and age comps), survey data every second year in the future (survey index of abundance and age comps)
- Fishing mortality can operate by area or total population

- Software designed to be flexible to allow multiple operating model configurations to capture a range of possible dynamics of the population and the fishery

Specific questions that the MSE simulations plan to address:

- Test the robustness of the current management procedure to current and future variability and changes in ocean conditions
- Test the robustness of the management procedure to an assessment model that does not include explicit spatial structure
- How can the EM be improved given uncertainty and potential future changes in spatial stock structure?
- How do parameters related to movement influence performance metrics?

Timeline:

Now - August 2018:

- Begin to condition preliminary operating model to available spatial data
- Begin to evaluate the performance of the current management procedure (in terms of performance metrics discussed in last call), using the preliminary operating model

August 2018- Dec 2019:

- Develop multiple operating models that capture important hypotheses about
- Condition operating model based on input from FATE Hake Project
- Perform simulations with spatially explicit EM and compare performance to current EM
- Subsequent or supplementary evaluations (TBD, iterative process)

Questions for the MSEWG to consider before the call:

- What assumptions in the preliminary operating model described above do you think are the most constraining or incorrect? What alternative OM configurations we should consider (e.g., higher spatial complexity, spatial selectivity)?
- How do you think catches should be implemented based on the harvest control rule:
 - Should full allocation be applied in both countries in all years? How do you think we should capture differences in attainment of the allocation of quota among sectors or countries?
- Do you think seasonality in catches makes a difference in the potential impacts of fishing on the population dynamics?
 - Do you think there are significant differences in fishing gear used in the U.S. and Canada that the operating model should try to represent, or are differences in ages observed in the catch only due to which fish are available in the two countries?
- How can we work to better link the FATE Hake project (and potentially other efforts) and prepare to use results from these projects to inform the MSE?